Crystal Set with Output Meter

I felt that it was not easy to evaluate sensitivity or level of output of a crystal set because human ears are not objective enough. There are several articles on the net about showing the output level as voltage or current. If you connect a voltmeter at the phone jack, the input impedance of the meter will affect the balance between the set's output impedance and the phones input impedance.

I found Mr. Billy Cheung in Hong Kong published an article about a crystal set with an output indicator (http://theradioboard.com/rb/viewtopic.php?f=2&t=6082). (http://theradioboard.com/rb/viewtopic.php?t=6082) It also seemed very nice set to build, so I did. I bought a DC current meter with -50 to +50 uA range at AliExpress. At that time it was the only model available. Since the meter is large, 10cm x 8cm, the case needs to be fairly big, 21cm x 10cm x 7cm.

There are three modifications (additions) to the original. I added a switch to make one of two gang variable capacitor, C1, a part of the tank circuit or an antenna impedance matching capacitor. A switch was added to increase the number of turns for the regeneration in case of MOSFET detection. The last change was to add a switch to increase capacitance of C2 by adding the second section of the air variable capacitor.

Because the case was large, wiring was easy. Therefore, it did not take so long to build the set, except making a few corrections on my stupid wiring errors, as usual.

Performance:

My antenna is about 12 m long wire hanging in my garden, and the ground is a 50 cm copper bar buried in the garden soil. In mode 1, sensitivity is good. We have three local stations, JOPK, JOPB, and JOVR, transmitted at 12 - 16 km distance with 10 kW power. After fine tuning, following values for output in uA were obtained. The values did not change by using different phones or amplifiers.

	1N60	3DQ
JOPK	6.3	8.5
JOPB	3.8	4.5
JOVR	3.8	5.0

Human feeling of loudness for JOPK cannot find any difference between the two detectors. I have no idea if the numbers above are high or low in my environment. No other stations were heard. Because of the capacitor layout in the output circuit, the output sound does not include high audio frequencies and, therefore, is soft, although I have not checked the frequency distribution.

Selectivity of 3DQ is good, while 1N60 gives broad tuning. However, this difference may not be caused by the detectors but by the circuit difference. In case of the diode, primary tank circuit has no tap, and the FET's source gets the signal from the tap.

In mode 2, over-all performance is not satisfactory. Sensitivity is not quite as good as mode 1, and selectivity is even worse. If you set the taps near the top (tap #2-4), you can hear several SW stations in China and Korea as well as domestic ones, but they can be picked up everywhere on the dial. Therefore, there is no way to know the frequency which the set is tuned. This may be caused by the unused part of the coils, lowering the Q, as Mr. Broesel pointed out in the original post by Mr. Cheung (http://theradioboard.com/rb/viewtopic.php?t=6082).

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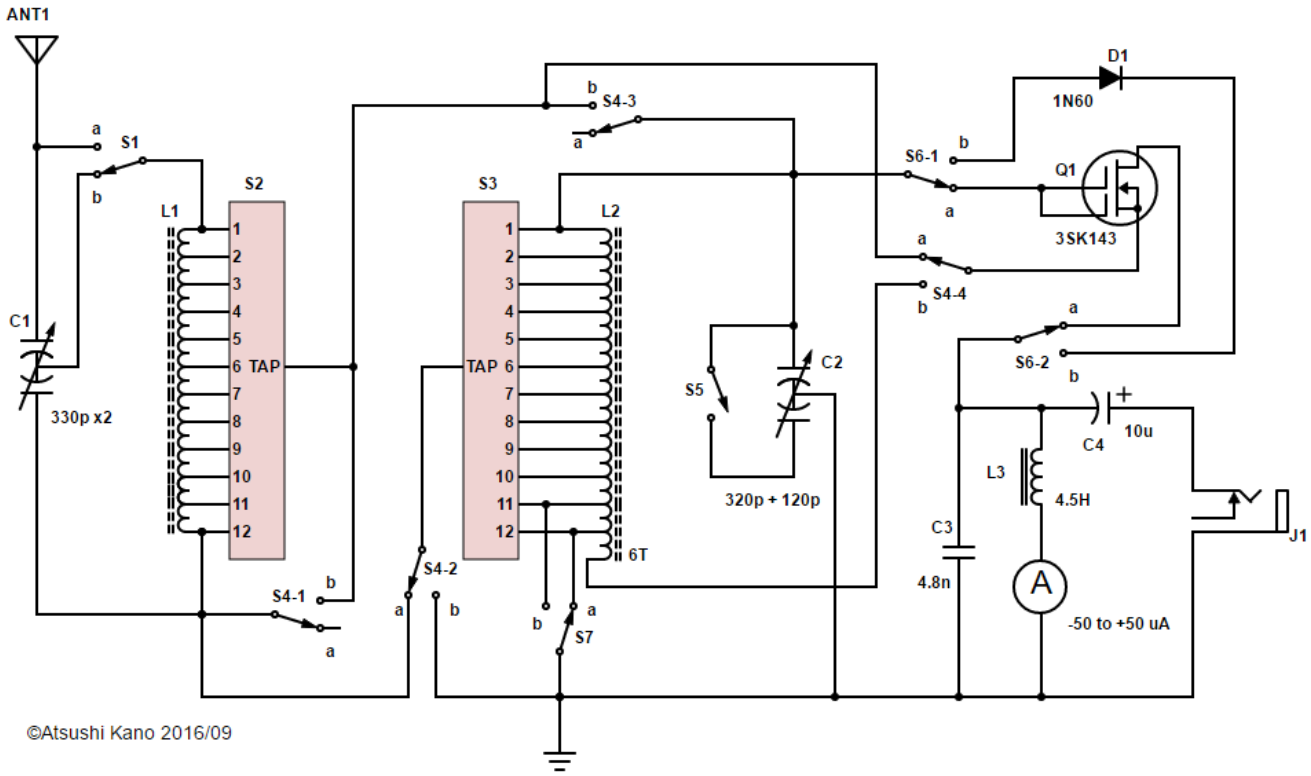
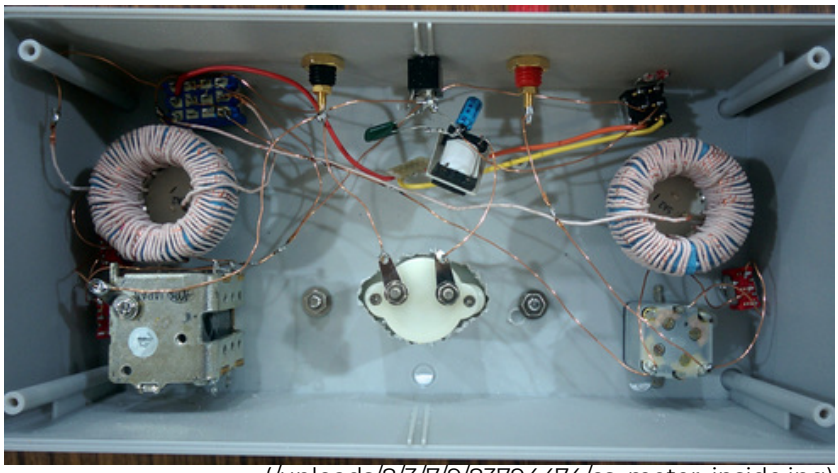


L1: R40C1 ferrite toroid with 250/46 litz wire. 315 uH. 10 taps at every 6 turn.
L2: same as L1 + 6T for regenaration.
L3: one side of 1:1 transformer. See original article by Cheung.
S1: 1/2 of C1 used (a) as a tank, (b) as an ANT impedance matching.
S2: Tap selecting rotary switch for primary tank.
S3: Tap selecting rotary switch for secondary tank.
S4: DP4T. (a) mode 1, (b) mode 2. See text.
S5: Add 120pF to C2.
S6: Detector selection. (a) 1N60, (b) 3SK143.
S7: (a) original, (b) add 6 turns for regeneration.
Q1: 3SK143 (3DQ). Two gates are connected.
C1: Alps two-section poly-variable capacitor.
C2: Alps two-section air variable capacitor.

(/uploads/8/3/7/9/83794474/cs_meter_face.jpg)

Face of the set

The case is TAKACHI TW11-8-22G, W110 x D220 x H75.3mm. You can tell how large the meter is.
I put the rotary switches for tap selection upside-down by mistake, so selecting the taps is confusing a little.



(/uploads/8/3/7/9/83794474/cs_meter_inside.jpg)

Inside

Since few parts were used except switches and variable capacitors, inside the case is almost vacant. The DP4T toggle switch was the most expensive among connectors and switches.
The 3DQ is hidden behind the small universal board, while the 1N60 is connected to the terminals of the switch.

(/uploads/8/3/7/9/83794474/cs_meter_left.jpg)

The switch to separate/combine the sections of the variable capacitor, C1 is shown.

(/uploads/8/3/7/9/83794474/cs_meter_top.jpg)

Phone jack and terminals are placed on the top (side) of the case.

(/uploads/8/3/7/9/83794474/cs_meter_right.jpg)

Mode switch and other switches for the secondary tuning are placed on this side.